

EXHIBIT I



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2/187

PATENTS
112056-0126
P01-1108

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re The Application of:)
Steven R. Kleiman et al.)
Serial No.: 10/105,034)
Filed: March 21, 2002)
For: A METHOD FOR WRITING)
CONTIGUOUS ARRAYS OF)
STRIPES IN A RAID STOR-)
AGE SYSTEM USING)
MAPPED BLOCK WRITES)

Examiner: Nguyen, Than Vinh

Art Unit: 2187

Cesari and McKenna, LLP
88 Black Falcon Avenue
Boston, MA 02210
August 17, 2005

"Express Mail" Mailing-Label Number: EV 432399523 US

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

AMENDMENT

This Amendment is filed in response to the Office Action mailed on May 17, 2005.
All objections and rejections are respectfully traversed.



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For: A METHOD FOR WRITING CON-)
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IN A RAID STORAGE SYSTEM)
USING MAPPED BLOCK WRITES)

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IN THE CLAIMS:

Please cancel claims 47, 50, and 83 without prejudice.

Please re-write the claims to read as follows:

- 1 1-16. (Cancelled)
- 2 17. (Currently Amended): A method for controlling storage of data in a plurality of storage
3 devices each comprising storage blocks configured in a plurality of parallel stripes, the
4 method comprising:
- 5 buffering a plurality of write requests associated with data blocks for a single write
6 transaction;
- 7 defining a group of storage blocks, the group comprising a plurality of storage blocks
8 in each of the plurality of storage devices; and
- 9 ~~mapping~~ associating each data block with a respective one of the storage blocks
10 across the plurality of stripes to generate an association; and
- 11 ~~, for~~ transmitting the ~~mapping~~ association to a storage device manager for proc-
12 essing of the single write transaction.
- 1 18. (Currently Amended): The method of claim 17, further comprising receiving by a file
2 system the plurality of write requests, and transmitting from the file system to the storage de-
3 vice manager the ~~mapping~~ association for processing of the single write transaction,
4 wherein the storage device manager comprises a RAID layer.

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1 | 19. (Currently Amended): The method of claim 17, wherein ~~mapping~~ associating com-
2 | prises associating each data block of at least one of the write requests with storage blocks of
3 | only one of the plurality of storage devices.

1 | 20. (Original): The method of claim 17, wherein defining the group of storage blocks com-
2 | prises receiving by the file system from the storage device manager configuration informa-
3 | tion of the plurality of storage devices.

1 | 21. (Original): The method of claim 20, wherein the configuration information comprises
2 | disk topology information.

1 | 22. (Original): The method of claim 17, wherein the group of storage blocks comprises
2 | more than one stripe in a RAID group.

1 | 23. (Original): The method of claim 22, wherein the group of storage blocks comprises
2 | more than one contiguous stripe.

1 | 24. (Currently Amended): The method of claim 23, further comprising transmitting the
2 | ~~mapping~~ association and the data to the plurality of storage devices to store each data
3 | block at the respective one of the storage blocks of the more than one contiguous stripe.

1 | 25. (Original): The method of claim 22, wherein the plurality of storage devices comprises
2 | more than one RAID group, and defining the group of storage blocks comprises defining the
3 | group of storage blocks from storage blocks in a first RAID group.

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1 26. (Currently Amended): The method of claim 25, further comprising defining a second
2 group of storage blocks in a second RAID group for association with data ~~mapped~~ associ-
3 ated with a second plurality of write requests for processing of a second write transaction.

1 27. (Currently Amended): The method of claim 17, further comprising queuing a plurality
2 of ~~mappings~~ associations by the storage device manager for processing of a plurality of
3 write transactions.

1 28. (Original): The method of claim 27, further comprising processing the plurality of write
2 transactions by the storage manager in an order derived from a plurality of priorities associ-
3 ated with the plurality of write transactions.

1 29. (Original): The method of claim 17, wherein the group of storage blocks comprises a
2 same quantity of storage blocks in each one of the plurality of storage devices.

1 30. (Original): The method of claim 29, wherein each of the plurality of storage blocks
2 comprises contiguous storage blocks.

1 31. (Original): The method of claim 17, wherein the group of storage blocks comprises allo-
2 cated and unallocated storage blocks.

1 32. (Original): The method of claim 31, wherein defining the group further comprises se-
2 lecting an unallocated storage block having a lowest block identifier of any unallocated stor-
3 age block as a storage block having a lowest storage block identifier of any storage block in
4 the group.

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1 33. (Original): The method of claim 17, wherein the write requests comprise data to be writ-
2 ten.

1 34. (Currently Amended): A method for storing data blocks, the method comprising:
2 providing a RAID layer in communication with a plurality of storage devices that
3 each comprise a plurality of storage blocks configured in a plurality of parallel stripes;
4 receiving by the RAID layer a write transaction request that includes ~~a mapping~~ an
5 association of each data block with a respective one of a group of storage blocks, the group
6 comprising a plurality of storage blocks in each of the plurality of storage devices across the
7 plurality of stripes; and
8 storing the data blocks by the RAID layer in the group of storage blocks according to
9 the ~~mapping~~ association.

1 35. (Original): The method of claim 34, wherein the RAID layer comprises a second plural-
2 ity of storage devices that each comprise a plurality of storage blocks that mirror storage
3 blocks of the plurality of storage devices, and further comprising storing the data in a group
4 of storage blocks of the second plurality of storage devices.

1 36. (Original): The method of claim 35, further comprising performing a parity determina-
2 tion for one of the groups of storage blocks prior to storing, and sharing a result of the parity
3 determination with the other of the groups of storage blocks.

1 37. (Original): The method of claim 36, further comprising selecting one of the groups of
2 storage blocks for performing the parity determination.

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1 38. (Original): The method of claim 34, further comprising monitoring by the storage de-
2 vice manager of configuration information of the plurality of storage devices.

1 39-41. (Cancelled)

1 42. (Currently Amended): A device for controlling storage of data in a plurality of storage
2 devices each comprising storage blocks configured in a plurality of parallel stripes, the de-
3 vice comprising:

4 a buffer collecting write requests, each request associated with data blocks;

5 a processor defining a group of storage blocks, the group comprising a plurality of
6 storage blocks in each of the plurality of storage devices, the processor ~~mapping~~ associating
7 each data block with a respective one of the storage blocks across the plurality of stripes for a
8 single write transaction; and

9 a transmitter transmitting ~~the mapping~~ an association to a storage device manager
10 for processing of the single write transaction.

1 43. (Currently Amended): An apparatus for storing data blocks, the apparatus comprising:

2 a plurality of storage devices that each comprise a plurality of storage blocks config-
3 ured in a plurality of parallel stripes; and

4 a storage device manager in communication with the plurality of storage devices, and
5 configured to receive a write transaction from a file system, the write transaction comprising
6 ~~a mapping~~ an association of each data block to a respective storage block of a group of
7 storage blocks, the group comprising a plurality of storage blocks in each of the plurality of
8 storage devices across the plurality of stripes.

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1 44. (Original): The apparatus of claim 43, wherein the storage device manager causes a par-
2 ity determination for the group of storage blocks prior to storing the data blocks in the group
3 of storage blocks.

1 45. (Currently Amended): A device for controlling storage of data in a plurality of storage
2 devices each comprising storage blocks configured in a plurality of parallel stripes, the de-
3 vice comprising:

4 means for buffering a plurality of write requests associated with data blocks for a sin-
5 gle write transaction;

6 means for defining a group of storage blocks, the group comprising a plurality of
7 storage blocks in each of the plurality of storage devices; and

8 means for ~~mapping~~ associating each data block with a respective one of the storage
9 blocks across the plurality of stripes, for transmitting ~~the mapping~~ an association to a storage
10 device manager for processing of the single write transaction.

1 46. (Currently Amended): A computer readable media, comprising: the computer readable
2 media containing instructions for execution in a processor for the practice of the method of,

3 buffering a plurality of write requests associated with data blocks for a single write
4 transaction;

5 defining a group of storage blocks, the group comprising a plurality of storage blocks
6 configured in a plurality of parallel stripes in each of a plurality of storage devices; and

7 ~~mapping~~ associating each data block with a respective one of the storage blocks
8 across the plurality of stripes, for transmitting ~~the mapping~~ an association to a storage de-
9 vice manager for processing of the single write transaction.

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1 47. (Cancelled)

1 48. (Currently Amended): An apparatus for storing data blocks, the apparatus comprising:

2 means for providing a RAID layer in communication with a plurality of storage de-
3 vices that each comprise a plurality of storage blocks configured in a plurality of parallel
4 stripes;

5 means for receiving by the RAID layer a write transaction request that includes a
6 ~~mapping~~ an association of each data block with a respective one of a group of storage
7 blocks, the group comprising a plurality of storage blocks in each of the plurality of storage
8 devices across the plurality of stripes; and

9 means for storing the data blocks by the RAID layer in the group of storage blocks
10 according to the ~~mapping~~ association.

1 49. (Currently Amended): A computer readable media for use with storing data blocks,
2 comprising: the computer readable media containing instructions for execution in a processor
3 for the practice of the method of,

4 providing a RAID layer in communication with a plurality of storage devices that
5 each comprise a plurality of storage blocks configured in a plurality of parallel stripes;

6 receiving by the RAID layer a write transaction request that includes a ~~mapping~~ an
7 association of each data block with a respective one of a group of storage blocks, the group
8 comprising a plurality of storage blocks in each of the plurality of storage devices across the
9 plurality of stripes; and

10 storing the data blocks by the RAID layer in the group of storage blocks according to
11 the ~~mapping~~ association.

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1 50. (Cancelled)

1 51. (Currently Amended): A method for controlling storage of data, comprising:

2 receiving one or more write requests associated with data blocks;

3 receiving topological information associated with storage blocks configured in a plu-
4 rality of parallel stripes of a storage system;

5 ~~mapping-~~ associating the data blocks with one or more storage blocks across the plu-
6 rality of stripes as an association; and

7 writing the data blocks, in response to the ~~mapping~~ association, to the one or more
8 storage devices in a single write request.

1 52. (Currently Amended): The method of claim 51, further comprising: transmitting the

2 ~~mapping-~~ association to a storage device manager.

1 53. (Currently Amended): The method of claim 51, further comprising: ~~mapping-~~ associat-
2 ing each data block with a single storage block.

1 54. (Currently Amended): The method of claim 51, further comprising: storing the data

2 blocks in the ~~mapping~~ association.

1 55. (Previously Presented): The method of claim 51, further comprising: storing the data

2 blocks in a memory of the storage system.

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1 56. (Currently Amended): The method of claim 51, further comprising: creating an array as
2 the mapping association.

1 57. (Previously Presented): The method of claim 51, further comprising: buffering a plural-
2 ity of write requests into the single write request.

1 58. (Previously Presented): The method of claim 57, further comprising: buffering, in a
2 buffer, the plurality of write requests into the single write request until a predetermined crite-
3 ria is met.

1 59. (Previously Presented): The method of claim 58, further comprising: meeting the criteria
2 when a buffer is full.

1 60. (Previously Presented): The method of claim 58, further comprising: meeting the criteria
2 when the single write request is a predetermined logical length.

1 61. (Previously Presented): The method of claim 51, further comprising: receiving topologi-
2 cal information of a plurality of storage devices of the storage system.

1 62. (Previously Presented): The method of claim 61, further comprising: using a RAID sys-
2 tem as the plurality of storage devices.

1 63. (Previously Presented): The method of claim 51, further comprising: using a plurality of
2 disks for the storage system.

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1 64. (Currently Amended): The method of claim 51, further comprising: transmitting the
2 ~~mapping-~~ association to the storage device manager.

1 65. (Currently Amended): The method of claim 51, further comprising: organizing the ~~map-~~
2 ~~ping-~~ association as a combination of columns and rows.

1 66. (Currently Amended): The method of claim 65, further comprising: ~~mapping-~~ associ-
2 ating each column with a storage device.

1 67. (Currently Amended): The method of claim 66, further comprising: ~~mapping-~~ associ-
2 ating each row with a stripe of the storage device.

1 68. (Currently Amended): The method of claim 67, further comprising: arranging the ~~map-~~
2 ~~ping-~~ association as a plurality of stripes on a plurality of storage devices.

1 69. (Currently Amended): A storage system, comprising:

2 a file system, the file system to receive one of more write requests associated with
3 data blocks;

4 a storage device manager, the storage device manager to generate topological infor-
5 mation of storage blocks configured in a plurality of parallel stripes of one or more storage
6 devices, and to send the topological information to the file system; and

7 ~~a-mapping~~ an association generated in the file system, the ~~mapping-~~ association
8 to ~~map-~~ associate the data blocks with one or more storage blocks across the plurality of
9 stripes of the one or more storage devices, the ~~mapping-~~ association to be sent to the stor-

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10 age device manager, the storage device manager to write the data blocks, in response to the
11 ~~mapping~~ association, to the one or more storage blocks as a single write request.

1 70. (Currently Amended): The storage system of claim 69, further comprising: a ~~mapping~~
2 an association that maps- associates each data block with a single storage block.

1 71. (Previously Presented): The storage system of claim 69, further comprising: a memory
2 to buffer the data blocks for the write request to the one or more storage devices.

1 72. (Currently Amended): The storage system of claim 69, further comprising: a memory to
2 store the ~~mapping-~~ association containing the data blocks.

1 73. (Previously Presented): The storage system of claim 69, further comprising: one or more
2 storage devices having storage blocks.

1 74. (Currently Amended): The storage system of claim 69, further comprising: an array as
2 the ~~mapping~~ association.

1 75. (Previously Presented): The storage system of claim 69, further comprising: a buffer in
2 the file system to receive the one or more write requests.

1 76. (Currently Amended): The storage system of claim 69, further comprising: an arrange-
2 ment of columns and rows in the ~~mapping~~ association.

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1 77. (Previously Presented): The storage system of claim 76, further comprising: each col-
2 umn representing a storage device of the one or more storage devices.

1 78. (Previously Presented): The storage system of claim 76, further comprising: each row
2 representing a stripe of the one or more storage devices.

1 79. (Previously Presented): The storage system of claim 69, further comprising: a plurality
2 of disks as the one or more storage devices.

1 80. (Previously Presented): The storage system of claim 69, further comprising: a RAID
2 system as the plurality of storage devices.

1 81. (Currently Amended): A storage system, comprising:
2 means for receiving one or more write requests associated with data blocks;
3 means for receiving topological information associated with storage blocks config-
4 ured in a plurality of parallel stripes of a storage system;
5 means for ~~mapping~~ associating the data blocks with one or more storage blocks
6 across the plurality of stripes as an association; and
7 means for writing the data blocks, in response to the ~~mapping~~ association, to the
8 one or more storage devices in a single write request.

1 82. (Currently Amended): A computer readable media, comprising: the computer readable
2 media containing instructions for execution in a processor for the practice of the method of,
3 receiving one or more write requests associated with data blocks;

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4 receiving topological information associated with storage blocks configured in a plu-
5 rality of parallel stripes of a storage system;
6 ~~mapping~~ associating the data blocks with one or more storage blocks across the
7 plurality of stripes as an association; and
8 writing the data blocks, in response to the ~~mapping~~ association, to the one or more
9 storage devices in a single write request.

1 83. (Cancelled)

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REMARKS

This Amendment is filed in response to the Office Action mailed on May 17, 2005. All objections and rejections are respectfully traversed.

Claims 17-38 and 42-83 are in the case.

Claims 17-19, 26-27, 34, 42-43, 45-46, 48-49, 51-54, 56, 64-70, 72, 74, 76, and 81-82 were amended to better claim the invention.

Claims 47, 50, and 83 were cancelled.

No claims were added.

At Paragraph 7 of the Office Action mailed on May 17, 2005, claims 17, 42, 45-47, 51, and 81-83 were rejected under 35 U.S.C. § 112 for insufficient antecedent basis for the recitation of "the mapping". Amendment of the claims is believed to satisfy the rejection.

Applicant respectfully urges that all art cited during prosecution of this Application is completely silent regarding "*associating each data block with a respective one of the storage blocks*" as claimed. See also Applicant's Specification at Page 19, lines 5-7 and Page 23, lines 21-26.

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Accordingly, independent claims 17, 42, 45-47, 51, and 81-82 are believed to be in condition for allowance.

Likewise, dependent claims 18-33 and 52-68 are believed to be dependent from allowable independent claims, and therefore in condition for allowance.

At Paragraphs 9-11 of the Office Action, claims 47, 50, and 83 were rejected. Applicant respectfully points out that claims 47, 50, and 83 are cancelled without prejudice.

At Paragraph 13 of the Office Action, claims 34-38, 43-44, 48-49, and 69-80 were allowed. Claims 34, 42-43, 48-49, 69-70, 72, 74, and 76 were amended to better claim the invention.

All independent claims are believed to be in condition for allowance.

All dependent claims are believed to be dependent from allowable independent claims and therefore in condition for allowance.

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Favorable action is respectfully solicited.

Please charge any additional fee occasioned by this paper to our Deposit Account

No. 03-1237.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "A. Sidney Johnston", is written over a horizontal line.

A. Sidney Johnston
Reg. No. 29,548
CESARI AND MCKENNA, LLP
88 Black Falcon Avenue
Boston, MA 02210-2414
(617) 951-2500